

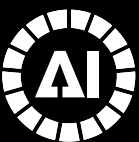
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technologies for good*

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COORDINATION BETWEEN NETWORKING AND COMPUTING RESOURCES FOR ENERGY SAVING IN DISAGGREGATED COMPUTING IN DATA CENTERS

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Japan

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sustainability, and emerging tech
ecosystems**

Why This Matter Now?



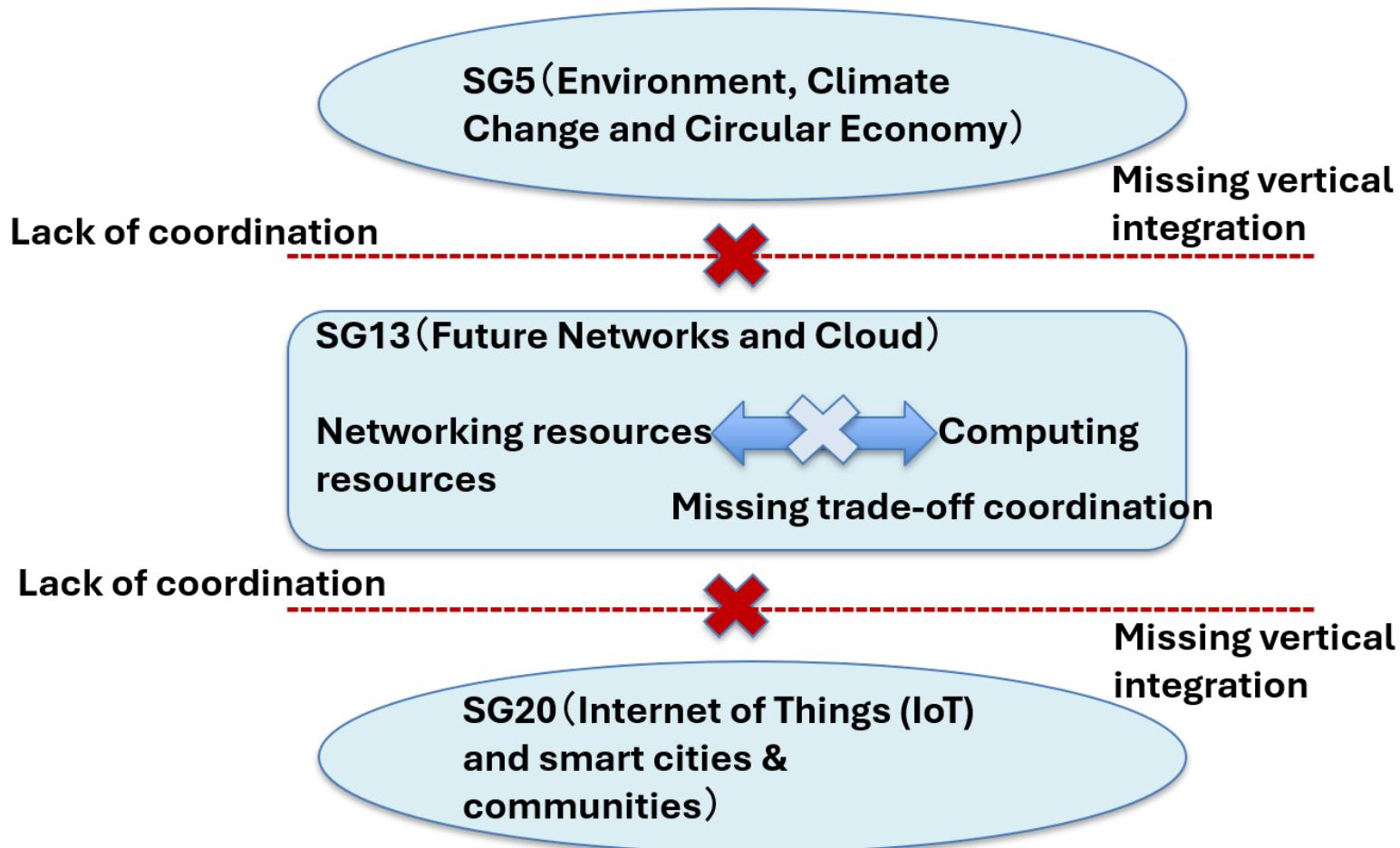
Digital Expansion

- Exponential growth in ICT data processing demands driven by 5G and AI.

Carbon Neutrality

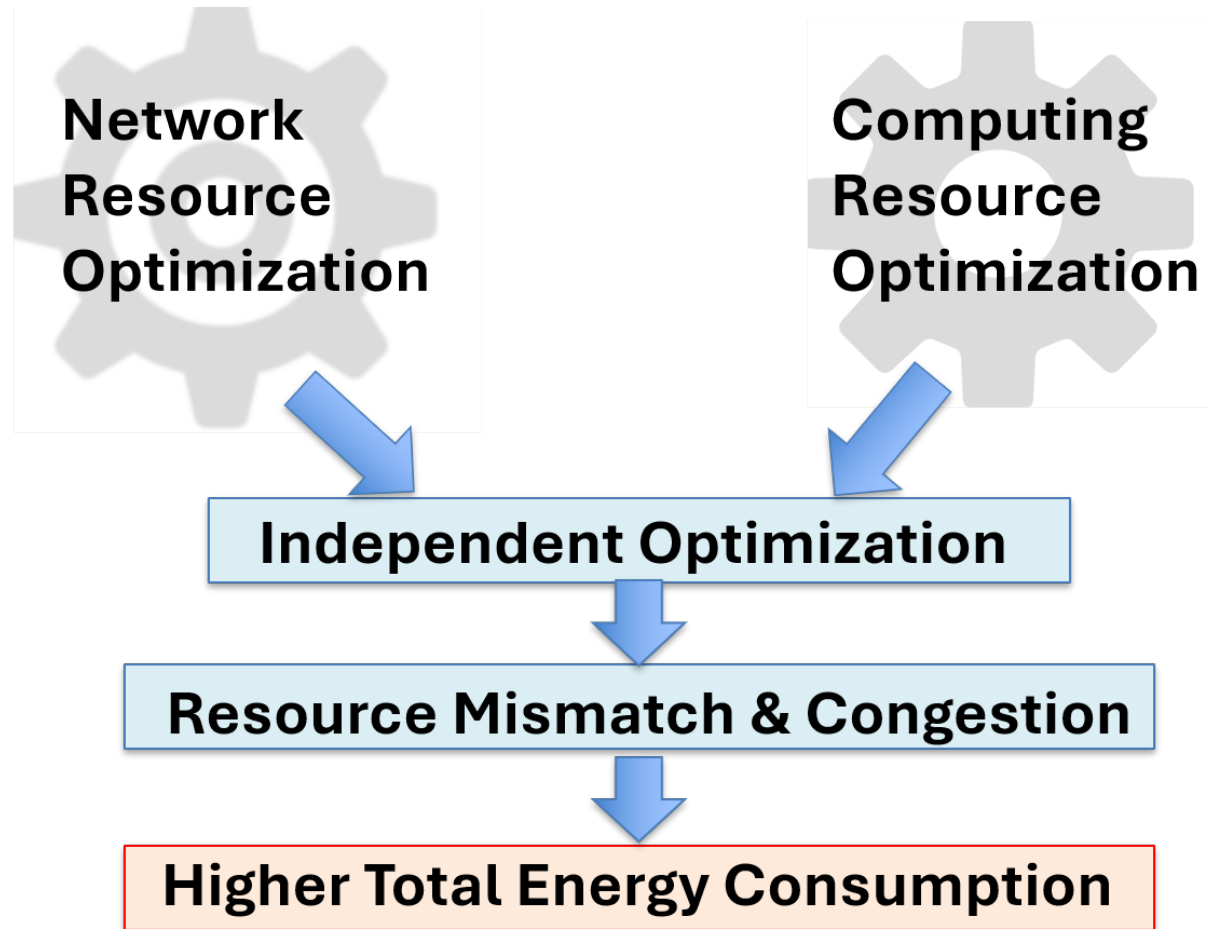
- Absolute reduction mandates governed by WTSA-24 resolutions and the 2015 Paris Agreement.

Fragmented Standards, Fragmented Energy Management



- Traditional standardization treats networking and computing as **independent entities**, resulting in fragmented discussions.
- **Lack of real-time cross-layer** signaling leads to inflexible allocations and the stranding of critical resources, wasting standby power.

The Energy Efficiency Paradox



Energy Efficiency Paradox

Key Observation

- Network and computing resources are optimized **independently**.
- Independent optimization **can increase total energy consumption**.
- Local optimization **does not always lead to** global energy efficiency.

Why Does the Paradox Occur?

Independent Optimization



Cross-Layer Dependencies and Ignored



Resource Mismatch



Congestion & Idle Resources

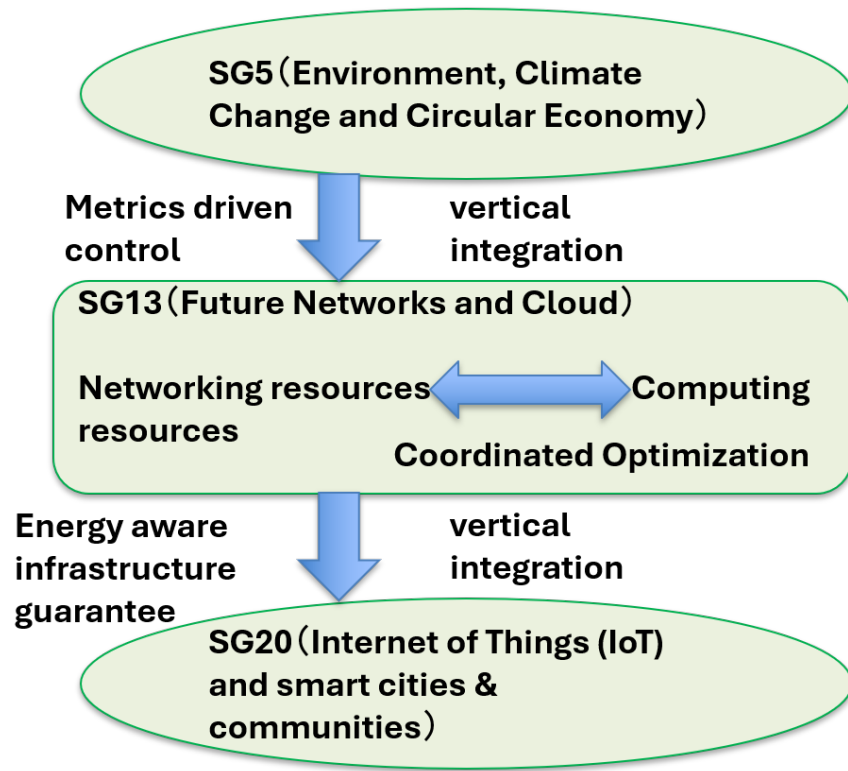


Higher Energy Consumption

Root Causes

- Cross-layer information **is not shared**.
- Independent decisions create **conflicting resource allocation**.
- The system **cannot achieve** global energy optimization.

Proposed Framework for Cross-SG Coordination



Key Features

- **Cross-layer coordination** across SG5, SG13, and SG20.
- **Joint optimization** of networking and computing resources.
- **Adaptive** energy management based on global system conditions.

Sustainability requirements should flow from SG5 to SG13 and SG20 to achieve globally optimized ICT systems.

Explainable Control for Cross-SG Coordination

Explainable Control

- Transparent decision-making
- Interpretable resource relationships
- Supports operational governance

Real-Time Adaptability

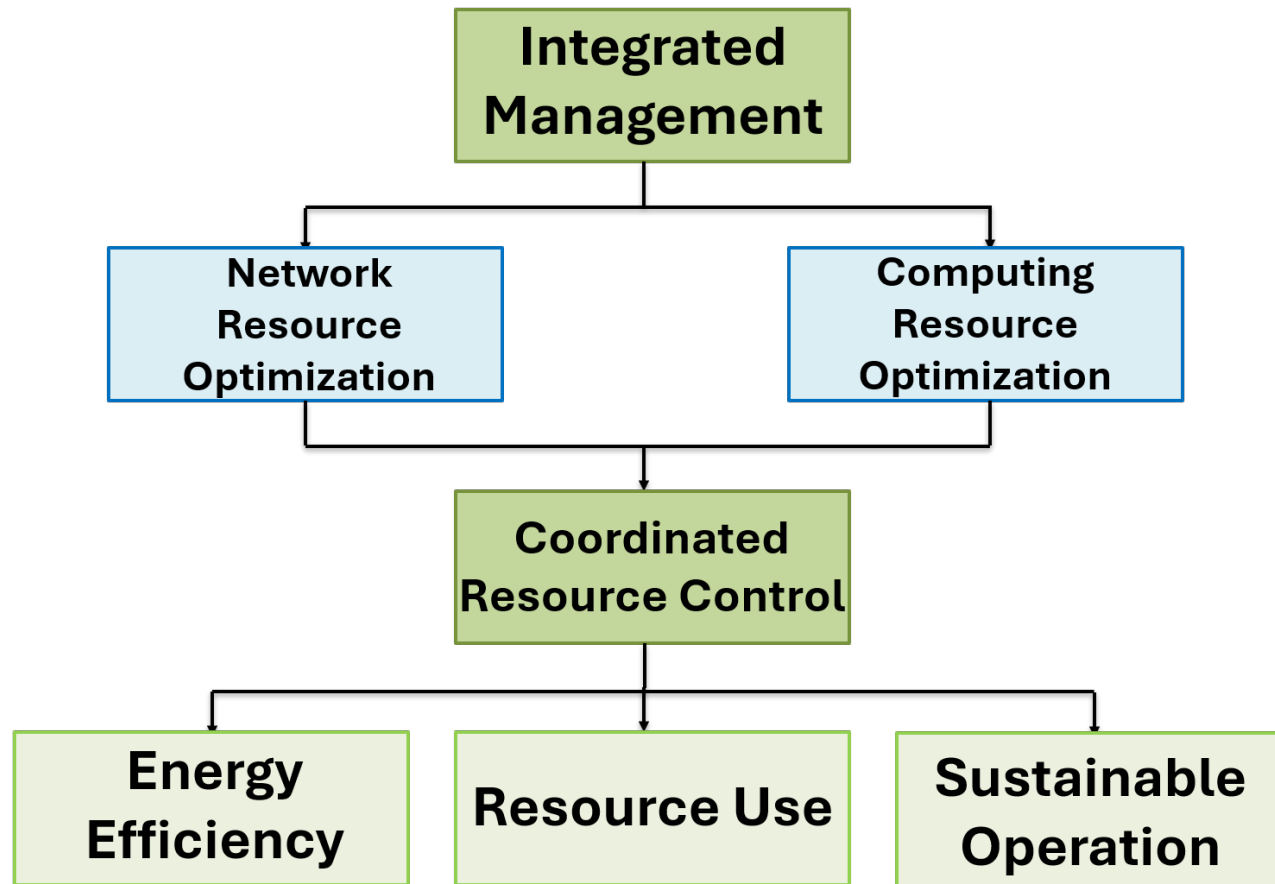
- Rapid online model updates
- Dynamic resource optimization
- Low computational latency

Low AI Overhead

- Lightweight computation
- Net-positive energy savings
- Suitable for continuous operation

Explainable Control supports transparent and coordinated decision-making across ITU-T Study Groups.

Global Benefits of Cross-SG Coordination



Energy Efficiency

- Reduces unnecessary energy consumption
- Enables coordinated energy-aware control

Resource Utilization

- Minimizes resource mismatch
- Improves cross-domain resource allocation

Sustainable Operation

- Supports long-term energy optimization
- Contributes to sustainable ICT systems

Integrated management enables global optimization across networking and computing domains.

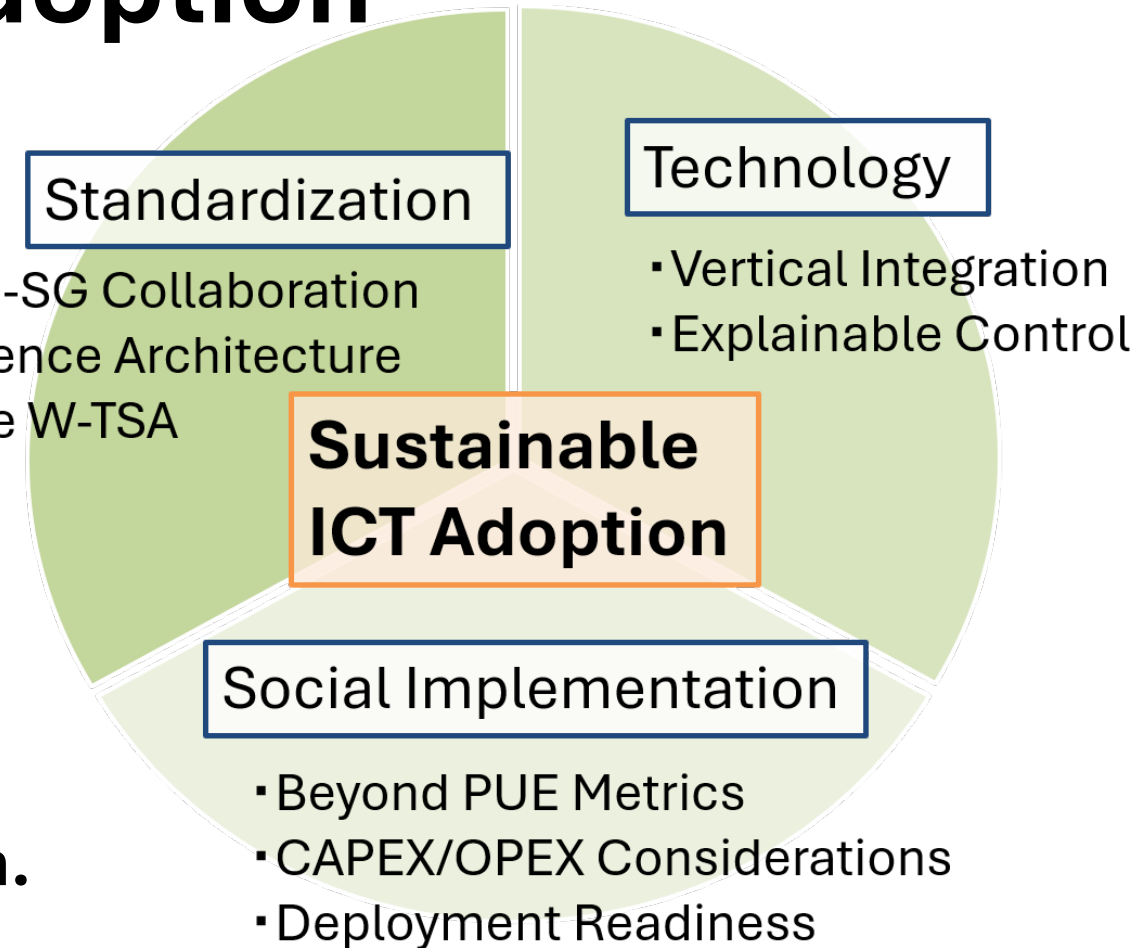
Global Benefits of Cross-SG Coordination

Vertical integration transforms fragmented management into system-wide optimization, creating a foundation for future ICT services and future standardization.

Integrated management enables global optimization across networking and computing domains.

Toward Widespread Adoption

- Breaking standardization silos is only the first step. Widespread adoption requires **coordinated progress in technology, standardization, and social implementation**.
- This work focuses on the **standardization** pillar while recognizing **the equal importance of technology and social implementation**.



This paper proposes a **Cross-SG coordination framework** for globally energy-efficient ICT standardization.

Conclusions

- **Overcoming the "Energy Efficiency Paradox"**

Demonstrated that fragmented optimization across networking and computing can increase overall energy consumption, highlighting the need for system-wide coordination.

- **Cross-SG Coordination through Explainable Control**

Proposed a practical coordination framework linking SG5, SG13, and SG20, supported by explainable and lightweight control for transparent resource management.

- **Toward Sustainable ICT Standardization**

Contributes to future discussions on coordinated ICT standardization for sustainable digital infrastructure. Technology, standardization, and social implementation must evolve together.

Thank you!

